High Rates of Uncontrolled Blood Pressure: Pulse Wave Velocity and Future Opportunities

Merrill Elias  
*University of Maine, mfelias@maine.edu*

Kevin Sullivan  
*University of Maine*

Gregory A. Dore  
*University of Maine*

Michael A. Robbins  
*University of Maine, robbins@maine.edu*

Follow this and additional works at: https://digitalcommons.library.umaine.edu/longitudinal_papers

Part of the Biomedical Engineering and Bioengineering Commons

**Repository Citation**
https://digitalcommons.library.umaine.edu/longitudinal_papers/82

This Letter to the Editor is brought to you for free and open access by DigitalCommons@UMaine. It has been accepted for inclusion in Maine-Syracuse Longitudinal Papers by an authorized administrator of DigitalCommons@UMaine. For more information, please contact um.library.technical.services@maine.edu.
To the Editors:

The recent commentary on high rates of uncontrolled blood pressure (BP) and opportunities for health care providers in this *Journal* prompted an examination of treated but uncontrolled BP in relation to pulse wave velocity (PWV) in the Maine Syracuse Longitudinal Study (MSLS). Cohen and Townsend noted that a Center for Disease Control analysis of National Health and Nutrition Examination Survey (NHANES) data (2003–2010) indicated that the presence of uncontrolled hypertension (≥140 mm Hg systolic and ≥90 mm Hg diastolic) in US adults was 53.5%. They further noted that approximately 45% of these individuals with uncontrolled hypertension were aware of their hypertension and were receiving treatment.

In the community-based MSLS, beginning in 1975 and concluding in 2008, there were 7 serial waves of data collection. After each wave of data collection, participants were made aware of prevalent and incident cardiovascular risk factors, including hypertension, and were referred to their physicians for treatment as usual. The 140/90 mm Hg criteria were the prevailing standards for BP control for waves 4 to 7 of the study. Failure to achieve control was observed for 40%, 41%, and 41% of the participants at waves 5, 6, and 7, respectively; polypharmacy was the predominant treatment mode.

In the last wave of MSLS (wave 7) for a subset of individuals participating in PWV studies, 95% of individuals with hypertension were being treated. Of these, 46% had BP levels defined as uncontrolled using the 140/90 mm Hg criteria. Data for PWV (m/s) and BP (mm Hg) parameters for treated hypertensive MSLS participants at wave 7 are shown in Table I to illustrate differences relating to BP control status. PWV for persons with untreated normal BP was 8.9 m/s (not shown), which was significantly lower than values for either the controlled or uncontrolled BP groups (P<.001).

The controlled and uncontrolled groups differed for sex but not for the 4 cardiovascular risk factors, age (years), diabetes mellitus, body mass index (>30 kg/m²), and total cholesterol (mg/dL) (Table II). Prevalence of all multiple cardiovascular diseases combined was 14% of the total sample. Table III shows categorical regression coefficients (b) relating controlled vs uncontrolled BP groups to PWV.

For all three covariate sets, significant associations remained with statistical adjustment for cardiovascular risk factors, although the magnitudes of the association were attenuated.

Our data are not original with respect to evidence that hypertension is the predominant risk factor for higher levels of PWV and, by inference, arterial stiffness. Clearly a causal association between BP control and PWV cannot be inferred; however, we present these data to illustrate an opportunity for further research. PWV is the gold standard indirect measure of arterial stiffness and there is growing evidence that it is very important in the early detection of vascular diseases. We especially need longitudinal studies and additional controlled clinical trials of medications that have been associated with reduction in PWV (eg, ACE inhibitors, calcium channel antagonists, and selective β-blocking agents). We also need trials with new candidate drugs that may facilitate the

### TABLE I. PWV and BP Parameters for Controlled and Uncontrolled Study Participants (46.4%) With Exclusion of Acute Stroke (n=33), Dementia (n=1), and Renal Dialysis (n=2)

<table>
<thead>
<tr>
<th>Blood Pressure No.</th>
<th>PWV</th>
<th>Systolic BP</th>
<th>Diastolic BP</th>
<th>Mean Arterial Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controlled</td>
<td>252</td>
<td>10.5 (2.8)</td>
<td>121.8 (11.1)</td>
<td>70.9 (6.5)</td>
</tr>
<tr>
<td>Uncontrolled</td>
<td>218</td>
<td>11.9 (3.2)</td>
<td>147.1 (18.1)</td>
<td>84.5 (8.6)</td>
</tr>
</tbody>
</table>

P value <.0001 <.0001 <.0001 <.0001

Values are expressed as mean (standard deviation). Pulse wave velocity (PWV) for the patients with normal blood pressure (BP) was 8.9.

### TABLE II. Demographic Information for Controlled and Uncontrolled Study Participants With Exclusion for Acute Stroke (n=33), Dementia (n=1), and Renal Dialysis (n=2)

<table>
<thead>
<tr>
<th>Blood Pressure</th>
<th>No.</th>
<th>Age</th>
<th>Female Sex, %</th>
<th>Education</th>
<th>Diabetes, %</th>
<th>Body Mass Index</th>
<th>Total Cholesterol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controlled</td>
<td>252</td>
<td>67.7 (10.7)</td>
<td>63</td>
<td>14.3 (2.8)</td>
<td>21.6</td>
<td>31.2 (7.4)</td>
<td>173.7 (36.7)</td>
</tr>
<tr>
<td>Uncontrolled</td>
<td>218</td>
<td>67.5 (12.4)</td>
<td>51</td>
<td>14.2 (2.8)</td>
<td>24.9</td>
<td>31.2 (7.2)</td>
<td>177.7 (38.1)</td>
</tr>
</tbody>
</table>

P value .83 .006 .83 .39 .93 .29

Values are expressed as mean (standard deviation) unless otherwise indicated.

doi: 10.1111/jch.12226
achievement of hypertension management goals without adding to what Cohen and Townsend\textsuperscript{1} describe as a “burdensome list of medications.”

Merrill F. Elias, PhD, MPH; Kevin Sullivan, BS; Gregory A. Dore, PhD; Michael A. Robbins, PhD
From the Department of Psychology and Graduate School of Biomedical Science and Engineering, University of Maine, Orono, ME

References


\begin{table}
\centering
\caption{Raw Regression Coefficients ($b$) Showing the Association Between Successful Control of BP and Lowered PWV With Adjustment for Covariates}
\begin{tabular}{|c|c|c|c|c|c|}
\hline
\textbf{Covariates} & \textbf{A+S+E} & \textbf{A+S+MAP} & \textbf{A+S+MAP+D+BMI+TC} \\
\hline
\textbf{b} & 95\% CI & \textbf{b} & 95\% CI & \textbf{b} & 95\% CI \\
\hline
\text{-1.41}$^a$ & 0.83 & 1.98 & \text{-0.99}$^b$ & 0.17 & 1.81 & \text{-0.86}$^b$ & 0.08 & 1.65 \\
\hline
\end{tabular}
\end{table}

Abbreviations: A, age; BMI, body mass index; BP, blood pressure; CI, confidence interval; D, diabetes; E, education; MAP, mean arterial pressure; PWV, pulse wave velocity; S, sex; TC, total cholesterol.

$^a$p<.01.
$^b$p<.05.